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A LOOK AT POSSIBLE EFFECTS THE BROMINE EXTRACTION PROCESS MAY HAVE ON FOREST VEGETATION IN ARKANSAS

by

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INTRODUCTION

In recent months a "Brine Study Committee" was convened at the Governor's request to evaluate the need for regulating bromine processing plant emissions. Four of the processing plants are located in Union County and two are in Columbia County, Arkansas.

One phase of the Committee's evaluation relates to possible effects of emissions upon the timber resource. The Arkansas Forestry Commission was asked by the Committee to determine what this effect might be.

On March 9-10, representatives of the Brine Study Committee, Arkansas Forestry Commission, Arkansas Oil & Gas Commission, private landowners and the U. S. Forest Service met to review some aspects of the bromine processing plant situation. These included:

- An explanation of the industrial process and probable emissions
- A review of reported effects on forest vegetation
- An examination of forest vegetation in the vicinity of four plant sites

This report is a summary of the meeting and field trip. The participants for all or part of the session were:

Charles Sullivan, Arkansas Forestry Commission

Charles Redding, Arkansas Forestry Commission

1/ Plant Pathologist, U.S. Forest Service, State & Private Forestry, Alexandria, Louisiana.

James Tiner, Arkansas Forestry Commission

Ralph Dumas, Chairman, Brine Study Committee Arkansas Oil and Gas Commission

Bill Wright, Arkansas Oil and Gas Commission

Irwin Stevens, Forestry Consultant

Robert Loomis, U. S. Forest Service

RESULTS

The Industrial Process and Probable Emissions -

The group was given a non-technical overview of the bromine extraction process. This process involves pumping brine from deep wells to the processing plant. Bromine is extracted at the plant, and the waste brine is then pumped back into the ground.

A variety of chemical emissions results from this process which may, either alone or in combination, have the potential for affecting nearby forest vegetation. Hydrogen sulfide was identified as one of the major emissions in question. Another possible emission identified was hydrogen chloride.

Occasionally the brine pipes burst and nearby forest vegetation is flooded with brine. Experience has shown that vegetation in these areas is killed quite rapidly.

Review of Reported Effects on Forest Vegetation -

Although most of the processing plants have been in operation for more than 10 years, there is little documented evidence of emission effects on adjacent vegetation. Recent landowner complaints and private forestry consultant records allege that the forest resource has been adversely affected. Most of the reported effects have been within 1-2 miles of the processing plants. In addition, symptoms are reported to be most evident from October to April with loblolly and shortleaf pine trees being the most severely affected. Symptoms of possible air pollution effects have not been reported on hardwoods or on other associated forest vegetation.

In November or December 1975, Arkansas Forestry Commission personnel noted a 10-acre loblolly pine plantation which had discolored foliage. These 20-30 foot trees became completely defoliated and then later refoliated with little or no mortality. The plantation is located in Union County about 0.7 miles south, and 2.5 miles west of two bromine processing plants. The cause of the problem was not determined, however, industrial emissions were suspected.

A brief literature review suggests that there are few reports of injury to forest vegetation by hydrogen chloride, and virtually nothing has been reported for hydrogen sulfide. In addition, it appears that with regard to these two pollutants, little is known about the sensitivity and relative susceptibility of common southern forest tree and plant species.[2/]

Examination of Forest Vegetation in the Vicinity of Four Plant Sites

Forest vegetation was examined near two plant sites in Union County and two plant sites in Columbia County. Needle necrosis on loblolly pine was much more evident on trees examined in Union County. No symptoms of possible emission effects were noted on other associated vegetation.

Where loblolly pine needle necrosis was found, it was most severe adjacent to the plant site. No symptoms were noted more than 0.5-0.7 miles from the emission source. On trees with severe needle necrosis, approximately 90 percent of the needles had half their length killed. This symptom became less severe at greater distances from the source.

Some tree mortality and tree stumps were noted in one area. Also, it appeared that some dead trees were being cut and removed from the forest adjacent to this plant site. No attempt was made to determine the cause of the mortality.

Samples of pine foliage were collected for laboratory analysis to determine if needle cast fungi had caused the needle necrosis. No evidence of needle fungi was found. Also, the trees were examined to see if there were other common forest insect or disease problems which could have caused the needle necrosis. None were found.

DISCUSSION

Air pollution can cause tree and plant injury and mortality. Some of the more dramatic effects are seen as discolored foliage, dieback, sparse crowns and mortality. Other effects, such as minute reductions in growth and shifts in plant populations, are less dramatic and difficult to measure.

Plants differ as to their relative susceptibility to a given pollutant or mixtures of pollutants. Furthermore, degree of plant injury is dependent on such factors as pollutant concentration, duration of fumigation and plant sensitivity. Plant sensitivity, in turn, is

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[2/] Jacobson, J. S. and A. C. Hill (ed.) 1970. Recognition of Air Pollution Injury: A Pictorial Atlas. Air Pollution Control Assoc., Pittsburgh, PA.

determined by several factors including: genetic makeup, soil moisture, stage of plant growth, nutrition, light, relative humidity and temperature.[3/]

Evaluation of air pollution effects is difficult. When plants are injured by an air pollutant, the symptoms are often the only remaining evidence of an air pollutant fumigation. The plant symptoms, then, provide a major basis for evaluation.[4/] An evaluation can be greatly strengthened if air quality data are available which show pollutant identity, concentration and fumigation duration prior to symptom development.

If the suspected source of pollution is a single, stationary "point source," certain field observations are valuable in diagnosing the problem. A pattern of injury will often be noted on nearby vegetation: the most severe injury will be found downwind from the source, and, whereas insects or diseases may be quite specific on which tree species they attack, air pollution will often injure a wide number of species. One should look for characteristic markings on weeds, conifers, hardwoods and crop plants. In addition, it is known that certain plants (bio-indicators) are very susceptible to certain pollutants; these plants should be examined specifically and carefully. Species known to be resistant should also be examined for absence of symptoms.[5/]

CONCLUSION

At the time of this evaluation little information was available concerning pollutant identities and concentration; pattern and duration of fumigations; and plant sensitivity. In addition, most of the hardwood and associated shrub vegetation was still dormant. Nonetheless, the pattern and type of symptom on loblolly pine suggests that there is a relationship between the industrial emissions and needle symptoms. In addition, it appears that under present conditions, most of the emission effects occur within two miles of the source.

Future evaluations would be more meaningful if supported by additional information about pollutant identities and concentrations; character and duration of fumigations; and plant sensitivity and relative sensitivity. Additional field observations could be helpful in delineating affected areas and in recording tree decline and mortality.

3/ Ibid.

4/ Ibid.

5/ USDA, Forest Service, 1974. Air Pollution and Trees in the East. Southeastern Area, State and Private Forestry, Atlanta, Georgia.